

TOUCH-PANEL-EQUIPPED DISPLAY DEVICE

TECHNICAL FIELD

[0001] The present invention relates to a touch-panel-equipped display device.

BACKGROUND ART

[0002] Conventionally, a configuration of a touch-panel-equipped display device wherein a touch panel is located on the display device has been known. A touch-panel-equipped display device has a problem that sensors of the touch panel are visible to a user, which deteriorates the display quality of the display device.

[0003] JP-A-2010-257492 discloses an electrostatic capacitance type input device that includes: a translucent substrate; a multilayer film that is formed on one of surfaces of the translucent substrate and that includes a plurality of translucent thin films that have different refractive indices, respectively, wherein one of the plurality of translucent thin films is a niobium oxide film; a plurality of first translucent electrodes that extend in a first direction; and a plurality of second translucent electrodes that extend in a second direction that intersects the first direction.

[0004] JP-A-2013-58180 discloses a touch panel that includes: a transparent substrate; a first metal electrode that is formed on one of surfaces of the transparent substrate, and is formed with first unit electrode lines repeatedly arrayed in parallel with one another; and a second metal electrode that is formed on the other surface of the transparent substrate, and is formed with second unit electrode lines repeatedly arrayed in parallel with one another, the second unit electrode lines intersecting the first unit electrode lines at right angles. The foregoing document discusses that with the configuration in which the first metal electrode or the second metal electrode, in a specific shape, is provided on each surface of the transparent substrate in combination, moire can be reduced.

SUMMARY OF THE INVENTION

[0005] In a touch-panel-equipped display device, moire occurs due to interference between sensors and the display device in some cases. Even if the visibility of the sensors of the touch panel is decreased, the deterioration of the display quality due to moire is not solved in some cases.

[0006] It is an object of the present invention to obtain a configuration of a touch-panel-equipped display device that enables suppressing the occurrence of moire.

[0007] A touch-panel-equipped display device disclosed herein includes: a color filter layer including a plurality of pixels that are arranged in matrix along a first direction and a second direction that intersect at a right angle; and a sensor pattern layer including a plurality of electrodes that are arranged along the second direction at a predetermined sensor interval SY, the sensor pattern layer being arranged so as to overlap the color filter layer when viewed in a direction vertical to the first direction and the second direction. Each of the pixels includes n color filters that transmit light in wavelength ranges different from one another, respectively, where n is an integer of 3 or more. The n color filters are arranged along the second direction at a predetermined subpixel interval CSFY. The sensor interval SY and the subpixel interval CSFY satisfy an expression (1) below:

$$CFSY \times (nxm+1) \leq SY \leq CFSY \times (nx(m+1)-1) \quad (1)$$

where m is a positive integer.

[0008] According to the present invention, a configuration of a touch-panel-equipped display device that enables suppressing the occurrence of moire can be obtained.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. 1 is a cross-sectional view schematically illustrating a configuration of a touch-panel-equipped display device according to Embodiment 1 of the present invention.

[0010] FIG. 2 is a plan view illustrating a configuration of a color filter layer.

[0011] FIG. 3 is a plan view illustrating a configuration of a sensor pattern layer.

[0012] FIG. 4 is a schematic cross-sectional view for explaining effects of the touch-panel-equipped display device.

[0013] FIG. 5 illustrates an example in a case where the setting of a sensor interval SY is inappropriate.

[0014] FIG. 6A is a plan view illustrating the color filter layer and the sensor pattern layer in an overlapped state, in a case where the sensor interval SY is set to three times the subpixel interval CFSY.

[0015] FIG. 6B is a plan view illustrating the color filter layer and the sensor pattern layer in an overlapped state, in a case where the sensor interval SY is set to four times the subpixel interval CFSY.

[0016] FIG. 6C is a plan view illustrating the color filter layer and the sensor pattern layer in an overlapped state, in a case where the sensor interval SY is set to five times the subpixel interval CFSY.

[0017] FIG. 6D is a plan view illustrating the color filter layer and the sensor pattern layer in an overlapped state, in a case where the sensor interval SY is set to six times the subpixel interval CFSY.

[0018] FIG. 7A is a plan view illustrating the color filter layer and the sensor pattern layer in an overlapped state, in a case where $\theta = \tan(1/3 \times CFSY/CFX)$ is satisfied.

[0019] FIG. 7B is a plan view illustrating the color filter layer and the sensor pattern layer in an overlapped state, in a case where $\theta = \tan(2/3 \times CFSY/CFX)$ is satisfied.

[0020] FIG. 7C is a plan view illustrating the color filter layer and the sensor pattern layer in an overlapped state, in a case where $\theta = \tan(5/3 \times CFSY/CFX)$ is satisfied.

[0021] FIG. 7D is a plan view illustrating the color filter layer and the sensor pattern layer in an overlapped view, in a case where $\theta = \tan(3 \times CFSY/CFX)$ is satisfied.

[0022] FIG. 8 is a table illustrating the relationship between the pixel interval CFX as well as the sensor interval SY, and the occurrence/non-occurrence of moire.

[0023] FIG. 9 is a table illustrating the relationship between the pixel interval CFX as well as the bias angle θ , and the occurrence/non-occurrence of moire.

[0024] FIG. 10 is a plan view illustrating a configuration of a sensor pattern layer of a touch-panel-equipped display device according to Embodiment 2.

[0025] FIG. 11A is a plan view illustrating a color filter layer and the sensor pattern layer in an overlapped state, in a case where a cycle SPN is set so that at a position where an end of an electrode shifts in the y direction over a distance of twice a subpixel interval CFSY, the electrode is turned.